



Notes on *Dineutus helleri* Ochs, 1925, with new records for the Cyclops Mountains Whirligig Beetle, *Dineutus h. stueberi* Ochs, 1955 (Coleoptera, Gyrinidae)

Suriani Surbakti¹, Michael Balke^{2*}, Jiří Hájek³, Grey Gustafson⁴

¹ Department of Biology, Universitas Cenderawasih, Waena, Papua, Indonesia • anisurbakti06@yahoo.com

² Department of Entomology, SNSB-Zoologische Staatssammlung, Munich, Germany • balke@snsb.de  <https://orcid.org/0000-0002-3773-6586>

³ Department of Entomology, National Museum, Cirkusová 1740, CZ-193 00 Praha 9 – Horní Počernice, Czech Republic • jiri.hajek@nm.cz  <https://orcid.org/0000-0001-5779-1542>

⁴ Department of Biological Sciences, Northern Arizona University, Flagstaff, AZ 86011, USA • gtgustafson@gmail.com  <https://orcid.org/0000-0002-2014-7128>

* Corresponding author

Abstract

We review *Dineutus helleri* Ochs, 1925, a whirligig beetle species endemic to New Guinea's north coast mountains. Its diagnostic characters are illustrated for easy species identification. We provide a summary and geographic interpretation of historical records, provide new records and, for the first time, habitat photographs for the subspecies *D. h. stueberi* Ochs, 1955, which is endemic to the Cyclops Mountains area. We also discuss the subspecies classification of this species.

Keywords

Aquatic Coleoptera, Indonesia, Papua, streams

Academic editor: Kirill Makarov | Received 27 April 2021 | Accepted 3 July 2021 | Published 20 July 2021

Citation: Surbakti S, Balke M, Hájek J, Gustafson G (2021) Notes on *Dineutus helleri* Ochs, 1925, with new records for the Cyclops Mountains Whirligig Beetle, *Dineutus h. stueberi* Ochs, 1955 (Coleoptera, Gyrinidae). Check List 17 (4): 1061–1066. <https://doi.org/10.15560/17.4.1061>

Introduction

Whirligig beetles (Gyrinidae) are a smaller family of about 800 species worldwide, yet, they are among the most conspicuous of aquatic insects. The adults are neuston dwellers, morphologically highly adapted to inhabiting the surface film of various aquatic habitats such as areas of streams or rivers with little to no current, as well as a variety of lentic habitats. Some gyrids form large aggregations of hundreds to thousands of individuals often involving multiple species or even genera (Young 1954; Realzola et al. 2007; Jäch et al. 2010).

Their oar-like middle and hind legs provide them with unrivalled swimming ability (Nachtigall 1961; Liu et al. 2018), fully divided eyes enable clear vision ventrally into the water, and dorsally into the air (Blagodatski et al. 2014). These carnivorous beetles use their specialized antennae (Kolmes 1983) to detect their prey, other insects on the water surface, which is then caught with their elongated forelegs (Beutel and Roughley 2016). When alarmed, the beetles dive to the bottom and hide, only to emerge again after a while. The larvae remain

largely elusive with their precise habitat unclear (Michat et al. 2017). Larvae possess lateral abdominal tracheal gills for breathing, and as such do not need to travel to the water surface to renew their air supply. Additionally, they may prefer oxygen rich water, in which case the presence of whirligig beetles could indicate comparably healthy ecosystems.

New Guinea and its satellite islands feature a rich fauna of Gyrinidae, with about 41 known species plus 27 subspecies (Polhemus 2011). The largest of them, up to 22.9 mm long (Brinck 1984), belong to the genus *Dineutus* Macleay, 1825. The approximately 100 known species of *Dineutus* have, roughly speaking, a pantropical distribution, including Central and North America, but are absent from South America (Gustafson and Miller 2017). New Guinea is a center of species diversity for *Dineutus*, with 23 species plus 11 subspecies reported from the island to date, almost all of which are endemic to one or a few areas of freshwater endemism (Polhemus 2011; Polhemus and Allen 2007).

In the context of an academic training and development project between the Department of Biology, Universitas Cenderawasih (UNCEN), Waena, Papua, Indonesia and Zoologische Staatssammlung, München, UNCEN biology staff initiated a survey of Cyclops Mountain streams on and near UNCEN campus. This area is densely populated and heavily used, presenting a fairly sharp transition between steeply rising forested slopes of the Cyclops Mountains and the hills leading to the northern shores of Lake Sentani. While the forest margin zone is more and more disturbed and pushed upslope by logging and gardening, mainly with the arrival of new settlers from the highlands of Papua, the rivers emerging from the deeply incised gorges remain comparably clean, thus offering opportunities for biodiversity assessment close to the UNCEN facilities.

Here, we focus on the large Gyrinidae found, *Dineutus helleri*, providing notes on the distribution and taxonomy of its two subspecies *D. helleri stueberi* and *Dineutus helleri helleri*, the whirligig beetle endemic to the Torricelli and Cyclops mountains.

Methods

This work was conducted by members of the Department of Biology, Universitas Cendrawasih, Waena, Papua, Indonesia, using a kitchen strainer otherwise used to collect other aquatic insects. Images were taken with a Canon EOS 5DS camera fitted with the Canon MPE65 macro lens, attached to a Stackmaster macro rail (Stonemaster: <https://www.stonemaster-onlineshop.de>). Illumination was with three or four LED segments SN-1 from Stonemaster. Image stacks were generated using the Stackmaster and images were then assembled with the computer software Helicon Focus v. 4.77TM.

Voucher specimens are stored in the Koleksi Serangga Papua (KSP), Department of Biology, Universitas Cenderawasih, Waena, Papua, Indonesia.

Results

Dineutus helleri helleri Ochs, 1925

Dineutus helleri helleri Ochs 1925: 7 (original description); Brinck 1983: 228 (redescription; new distributional data).

Type locality and type collecting data: Papua New Guinea: Sandaun or East Sepik Province, Torricelli Mts., January 1910, Collector: O. Schlaginhaufen.

Known localities. Data from Brinck (1983). PAPUA NEW GUINEA – **Sandaun Province** • Sea Falls near Afua; alt. 500 m; approx. position from GoogleEarth –03.3197, 142.5847; 1939; P.G. Moore leg. – **East Sepik Province** • Prince Alexander Mountains, Maprik; 15.VII.1950; approx. position from GoogleEarth –03.6495, 143.0605; W.W. Brandt leg. • Torricelli Mts.; Sugoitei Village; approx. position from GoogleEarth –03.5303, 142.0576; alt. 900 m; 6–9.II.1959; W.W. Brandt leg. • INDONESIA – **Papua Province** • Mount Nomo, south of Mount Bougainville; position inferred from Hämäläinen and Orr (2016) and Cheesman (1938) is the area immediately at the present-day PNG border, west of Nyao village in PNG: –02.8079, 141.0543; alt. 200 m; II.1936; L.E. Cheesman leg. (in the company of W. Stüber); 8 individuals • Njau-limon (might refer to modern day “Nyao”; <http://papuaweb.org/bib/hays/loc/index.html>); south of Mount Bougainville; position inferred from Hämäläinen and Orr (2016) and Cheesman (1938) is the area near –02.8079, 141.0543; alt. 100 m; II.1936; L.E. Cheesman leg. (in the company of W. Stüber); 1 individual • Stream between Tjahe River and Jasa River; the position –02.7495, 140.9839 after Fransen et al. (1997); 13.VI.1940; P.N. van Kampen leg.; 4 individuals.

Identification. The species was identified based on the original description by Ochs (1925, 1955), the redescription and identification key by Brinck (1983), as well as the study of reference specimens from the Torricelli Mountains in Papua New Guinea, housed in the Natural History Museum London.

Diagnosis (adopted from Brinck 1983). Body length: ♂ 12.8–18.0 mm, ♀ 13.0–15.7 mm; habitus convex (Fig. 1 B). Dorsal side olive-green with metallic reflexion, ventral side dark brown with margins of apical abdominal ventrite brighter. Dull elytral stripe broad anteriorly, then attenuated, and terminating at epipleural angle (♂) or before angle (♀). Lateral margin of elytra posteriorly concave, with epipleural spine more or less distinct; elytral truncature with outer excision deep, enlarged middle part obtuse and epipleural angle prominent. Distal outer angle of protibia not prominent. Aedeagus depicted in Figure 1D and E.

Distribution. Recorded from the Bewani, Torricelli, and Prince Alexander mountain ranges along the northern coast of Papua New Guinea (Sandaun and East Sepik provinces) (Fig. 2); several records came also from the

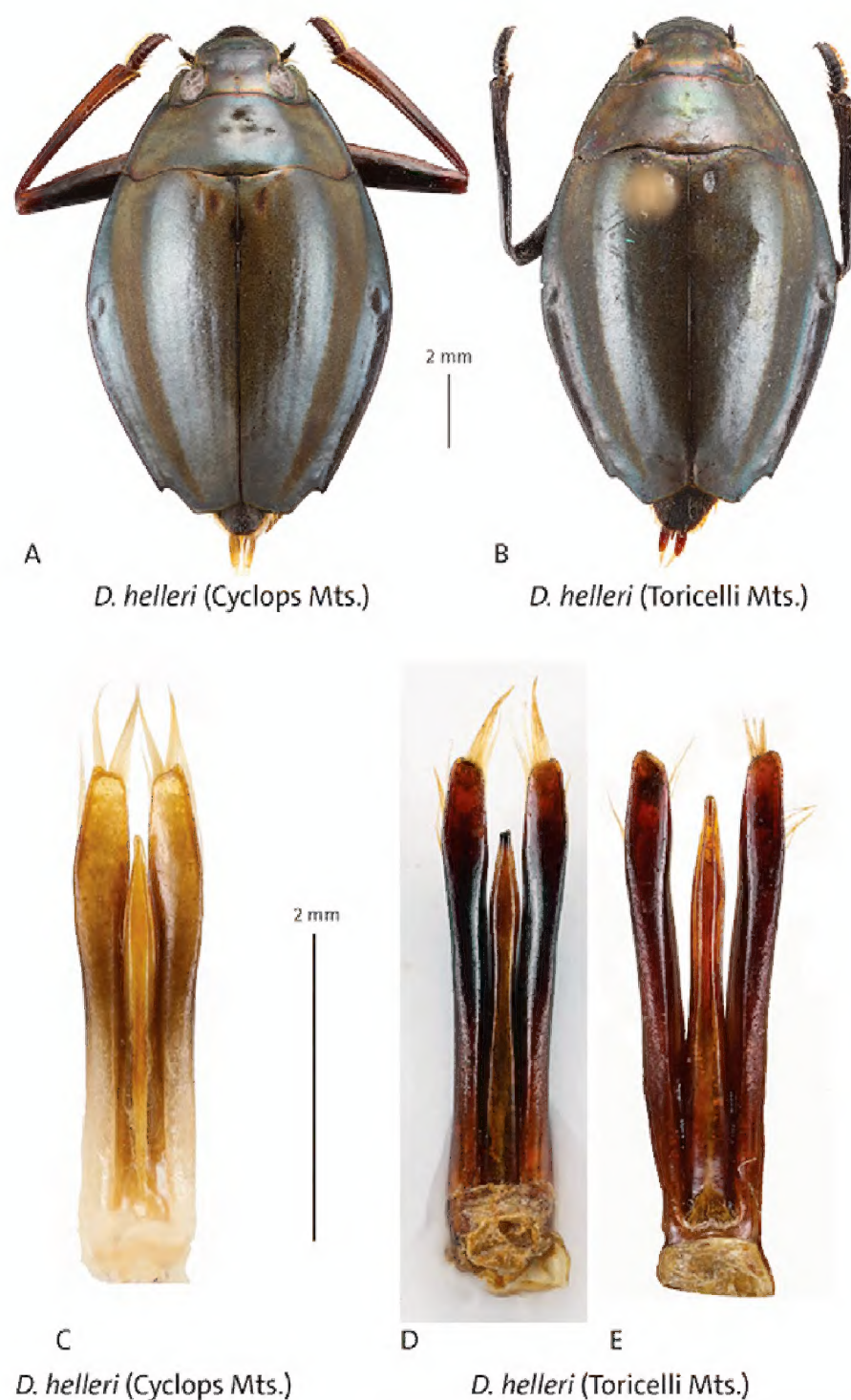


Figure 1. *Dineutus helleri*. Habitus dorsal. **A.** *Dineutus helleri stueberi*, Kamp Wolker River. **B.** *Dineutus helleri helleri*, Torricelli Mts. Median lobe of aedeagus in dorsal view. **C.** *Dineutus helleri stueberi*, Kamp Wolker River. **D, E.** *Dineutus helleri helleri*, Torricelli Mts.

vicinity of Mount Bougainville (supposedly) in Indonesian Papua, east from Tami river; the altitude of findings ranges between 100–900 m a.s.l.

Dineutus helleri stueberi Ochs, 1955

Dineutus helleri stueberi Ochs 1955: 146 (original description); Brinck 1983: 230 (redescription; new distributional data); Polhemus 2011: 58 (new distributional data).

Type locality and type collecting data: Indonesia, Papua Province, “Hollandia” (= currently Jayapura), 1933, Collector: W. Stüber. Coordinates for Jayapura city area inferred by us using GoogleEarth are -02.5409 , 140.6988 . Wilhelm Stüber was a German colonist and explorer, based around “Hollandia” in the 1930s, and a keen insect collector (Hämäläinen and Orr 2016). He was active around the Cyclops Mountains and later also localities towards the south, along the present-day Papua New Guinea border (Cheesman 1938; Hämäläinen and Orr 2016).

Known localities. INDONESIA – **Papua Province.** Data from Brinck (1983) • 4 individuals: Jayapura;

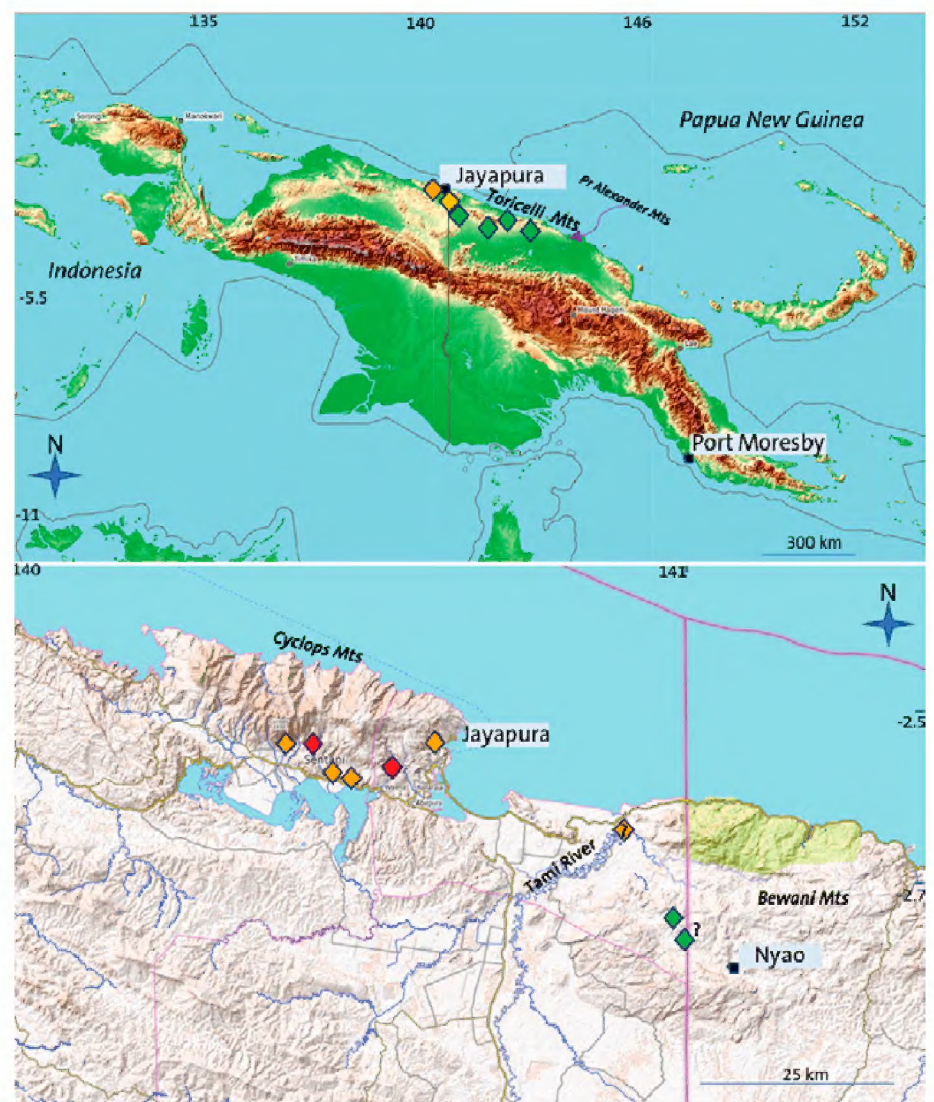


Figure 2. *Dineutus helleri*. Distribution overview of localities in New Guinea (above) and focus on the Jayapura area (below). *Dineutus helleri helleri* = green diamonds; *D. helleri stueberi* published localities = orange; *D. helleri stueberi* new localities = red. Map generated using the OpenTopoMap layer in gps visualizer (<https://www.gpsvisualizer.com/>) and edited using Microsoft Powerpoint.

IV.1945; B. Malkin • Tami River; Tami River is east of Jayapura City, the overflow of Lake Sentani drains into that river, it's mouth is located at -02.6364 , 140.9265 , note that the actual collecting site might be much further inland; 1930; R. Voorhoeve leg.; 2 individuals • Ifar; Cyclops Mountains; Sentani area ca. -02.5484 , 140.5504 ; alt. 300–500 m; 23–25.VI.1962; J. Sedlacek; 20 individuals • light trap; Sentani; SW Cyclops Mountains; position of the mountain stream closest to Sentani approx. -02.5406 , 140.5128 ; alt. 100 m; 15.VI.1959; J.L. Gressitt & T.C. Maa leg.; 1 individual • W Sentani, Cyclops Mountains; position of the mountain stream closest to Sentani ca. -02.5406 , 140.5128 ; alt. 50–100 m; J.L. Gressitt leg.; light trap; 1 individual • Gen Maj Quantkamp; N of Lake Sentani; Ifar; Sentani area approx. -02.5484 , 140.5504 ; alt. 450 m; 30.XI. 1955; L. D. Brongersmaa leg.; 21 individuals • Ifar; ca. -02.5484 , 140.5504 ; alt. 300 m; 16.IX.1959; C. van Heyningen leg.; 26 individuals • Hijob; most likely referring to Hubay River flowing out of the Cyclops Mountains into Lake Sentani in the Tanjung Elmo area, position of river at foot of the mountains at 170 m is -02.5687 , 140.5775 , the river flows into the lake at ca. 80 m altitude; alt. 25 m (this altitude cited by Brinck (1983) might be too low); 10.IX.1956; Netherlands New Guinea Expedition leg.; 7 individuals • Bulobay S of Jayapura (most likely referring to Blombay which is currently known as Telaga Maya); position of the stream at Telaga Maya our inference: ca. -02.5841 , 140.5989 ; alt. 200 m; 4 individuals. Data from Polhemus

(2011) • rocky stream above Pos Tujuh, NW of Sentani; −02.5406, 140.5128; alt. 260–300 m; 18.IX.2000; D.A. Polhemus leg.; 9 individuals.

New records. INDONESIA – **Papua Province** • Jayapura District; 5 km NE of Sentani; S slopes of Cyclops Mts.; Mount Ifar; −02.5467, 140.5533; 315 m; 30 Jan. 2015; J. Hájek, J. Šumpich obs.; >15 individuals observed swimming • Jayapura District; Waena, Kamp Wolker River, near UNCEN campus; alt. 60 m; 26.V.2019; −02.5686, 140.6474: Suriani, Walle, Sumoked leg.; 2 males collected, KSP (UNCEN_KSP_GYR_003 and 004), >20 individuals observed swimming.

Diagnosis. Body length: ♂ 14.8–17.2 mm, ♀ 13.4–15.9 mm; habitus similar to nominate form (Fig. 1 A). Lateral excision of truncature deeper than in typical subspecies, epipleural angle more developed, spine distinct. Middle part of truncature usually angular. Apex of median lobe of aedeagus shorter, stout, distally bent upwards (Fig. 1C).

Dineutus helleri stueberi is sympatric with another New Guinea endemic species, *Dineutus t. tetracanthus* Régimbart, 1906 (Brinck 1983). However, we did not observe the latter species in the Cyclops Mountains. *Dineutus tetracanthus* can be easily recognized from *D. helleri* based on the presence of additional distinct spine in the middle of elytral truncature.

Habitat. Our beetles were collected from the margins of clear, partly shaded mountain streams and also observed aggregated on calmer water behind large boulders (Fig. 3). At Kamp Wolker River, we also found several species

of aquatic bugs (Heteroptera) (https://zsm-entomology.de/wiki/UNCEN_Locality_2021_001) in the genera *Rhagovelia* Mayr, 1865, *Enithares* Spinola, 1837, *Idiocarus* Montandon, 1897, and *Sagocoris* Montandon, 1911. These cover various stream habitats and aquatic lifestyles: walking on the water surface, swimming in the water column in stream pools, and (in the latter two genera) more hidden on the bottom, under stones and debris in the current.

Polhemus (2011: 58) wrote: “At Pos Tujuh, on the southern flank of the Cyclops Mountains, this species was taken from a clear, steeply dropping stream flowing in a bed of very large boulders, partially shaded by disturbed rain forest.”

Distribution. Endemic to the Cyclops Mountains and its water system south to Lake Sentani and east to the Jayapura Plain as far as the Tami River; the altitude of findings ranges between 50 and 500 m a.s.l. (Fig. 2).

Discussion

Comments on classification. The subgeneric classification of *Dineutus* was considerably revised by Gustafson and Miller (2017) based on phylogenetic data, such that the prior subgenera *Merodineutus* Ochs, 1955 and *Rhombodineutus* Ochs, 1929 which comprise species endemic to New Guinea and New Britain of the Bismarck Archipelago (Ochs 1955; Brinck 1976, 1983, 1984), have been subsumed into *Dineutus s. str.* along with species from Southeast Asia and the Malay Archipelago. In the past, members of the now defunct subgenus *Rhombodineutus*,

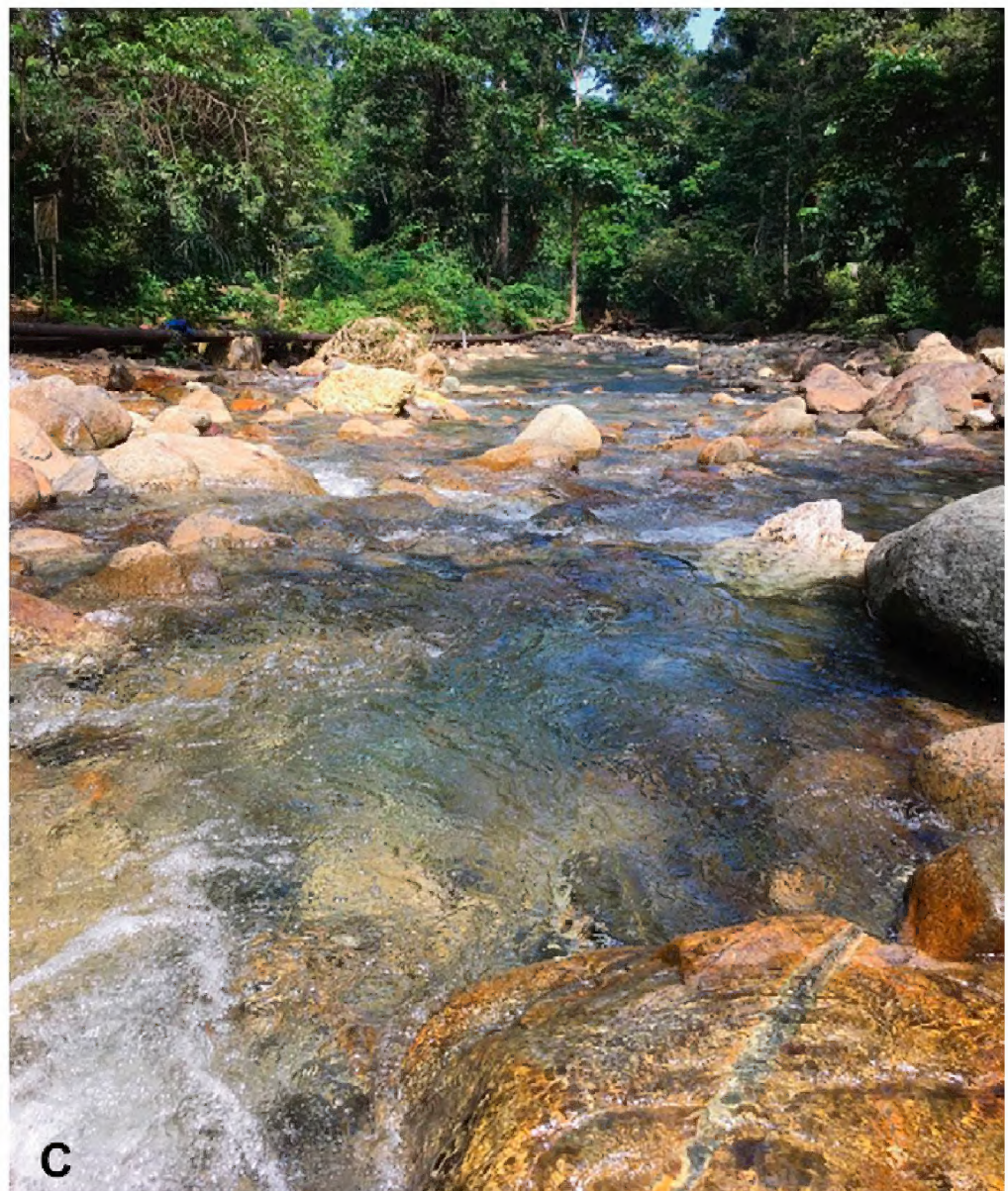


Figure 3. *Dineutus helleri stueberi*. Habitat. **A.** Mount Ifar. **B, C.** Kamp Wolker.

like *D. helleri*, were primarily diagnosed by their elongate, semicircular labrum and “rhomboid” dorsal habitus (Ochs 1955; Brinck 1983). However, these non-discrete features are similar to those found in *Rhomborhynchus*, another *Dineutus* subgenus endemic to New Guinea and its surrounding islands, except the labrum is more triangular in shape rather than semicircular. Members of *Dineutus s. str.* can now be unambiguously identified by the possession of a glabrous protrochanter, which distinguishes them from the other two currently recognized *Dineutus* subgenera, *Rhomborhynchus* and *Cyclous*; these subgenera instead have the protrochanter with a series of stout setae along its ventral face (Gustafson and Miller 2017). All three subgenera of *Dineutus* are known to occur in New Guinea (Polhemus 2011).

The phylogenetic analysis of the New Guinea *Dineutus s. str.* species has, thus far supported them as forming a monophyletic group (Gustafson and Miller 2017). Further, phylogenetic investigations should be undertaken incorporating additional New Guinea species, like *D. helleri*, and particularly members of the subgenus *Rhomborhynchus* (see Gustafson and Miller 2016, 2017) whose phylogenetic placement has yet to be robustly tested. Such investigations will lead to a better understanding of the evolution of this interesting clade of whirligig beetles. Additionally, numerous subspecies have been described which are very difficult to distinguish morphologically (Brinck 1983, 1984). This group would undoubtedly benefit from integrative taxonomic work (Dayrat 2005; Schlick-Steiner et al. 2010; Will et al. 2005) incorporating molecular and ecological data to help refine species boundaries. Polhemus (2011) found that several New Guinea *Dineutus* species and subspecies appeared specific to habitats with a particular substrate and geochemistry. This high degree of local endemism coupled with a habitat preference of clean stream habitats suggests that the genus *Dineutus* could be a worthwhile subject of study for biogeography and conservation biology in New Guinea.

The two subspecies of *D. helleri* were differentiated based on subtle morphological differences such as the truncature of elytron and the shape of male genitalia (Ochs 1955; Brinck 1983); however, Brinck (1983) already pointed out that the elytral truncature varies significantly within the specimens, and the only constant character seems to be the shape of apical part of median lobe of aedeagus: the apex should be longer and slender in nominate form and shorter and stouter in Cyclops specimens. However, this character also varies in the material studied, in particular, the apex of the median lobe is not stouter than in the nominate form (compare Fig. 1). Therefore, the two subspecies are currently delineated mainly based on their distribution (Fig. 2). However, the type localities of both taxa are only roughly 200 km apart, and their ranges are almost in contact at the Papua-New Guinea border east of Jayapura. In addition, the Tami River, which currently separates the subspecies, does not represent a barrier for large flying *Dineutus*.

As a result, we cannot exclude the possible synonymy of both nominal taxa; however, additional, preferably molecular study is required to solve the status of the subspecies of *D. helleri*.

Conservation. The association of gyrids to clear unspoiled running water makes these beetles good indicators of the quality of the habitat. Their large size and relatively easy observation and identification suggest the use of *Dineutus* as a flagship species for conservation of bodies of running water in New Guinea. Those habitats are considerably threatened both by direct pollution and the flushing of soil due to deforestation and gardening in the area. Of note, Brinck (1983) mentioned *Dineutus* specimens collected during the 1950s around Sentani at altitudes of 50–100 m a.s.l. However, this area is currently heavily inhabited and exploited, and our preliminary inspection did not confirm the occurrence of any water beetles there. All recently observed specimens of *D. h. stueberi* were found in streams and rivers of the Cyclops Mountains above settlements and cultivated areas surrounding Lake Sentani.

Acknowledgements

We are grateful for the generous support from the SNSB-Innovative scheme, funded by the Bayerisches Staatsministerium für Wissenschaft und Kunst. We thank Maxwell V.L. Barclay and Christine Taylor of the Natural History Museum London for the loan of reference specimens. We thank Dr. Herbert Zettel for identifying our aquatic Heteroptera. The work of J. Hájek was supported by the Ministry of Culture of the Czech Republic (DKRVO 2019–2023/5.I.c, National Museum, 00023272).

Authors' Contributions

Conceptualization: SS, MB. Investigation: SS, JH, GG, MB. Writing – original draft: SS, MB, JH, GG. Writing – review and editing: SS, MB, JH, GG.

References

- Beutel RG, Roughley RE (2016) 7.1. Gyrinidae. In: Beutel RG, Leschen RAB (Eds.) Handbook of zoology, Vol. IV, Arthropoda: Insecta Part 38 Coleoptera, Vol 1: Morphology and Systematics (Archostemata, Adephaga, Myxophaga, Polyphaga (partim)). Walter De Gruyter, Berlin/New York, 43–62.
- Blagodatski A, Kryuchkov M, Sergeev A, Klimov AA, Shcherbakov MR, Enin GA, Katanaev VL (2014) Under- and over-water halves of Gyrinidae beetle eyes harbor different corneal nanocoatings providing adaptation to the water and air environments. Scientific Reports 4: 6. <https://doi.org/10.1038/srep06004>
- Brinck P (1976) The Gyrinidae of the Bismarck Archipelago and the Solomon Islands (Coleoptera: Gyrinidae). Insect Systematics & Evolution 7: 81–90.
- Brinck P (1983) A revision of *Rhombodineutus* Ochs in New Guinea (Coleoptera: Gyrinidae). Insect Systematics & Evolution 14: 205–233.
- Brinck P (1984) Evolutionary trends and specific differentiation in

- Merodineutus* (Coleoptera: Gyrinidae). International Journal of Entomology 26: 175–189.
- Cheesman LE (1938) The Cyclops Mountains of Dutch New Guinea. The Geographical Journal, London 91: 21–30.
- Dayrat B (2005) Towards integrative taxonomy. Biological Journal of the Linnean Society 85: 879–886. <https://doi.org/10.1111/j.1095-8312.2005.00503.x>
- Gustafson GT, Miller KB (2016) Revision of the Southeast Asian whirligig beetle genus *Porrorhynchus* Laporte, 1835 (Coleoptera: Gyrinidae: Gyrininae: Dineutini). The Coleopterists Bulletin 70: 675–714. <https://doi.org/10.1649/0010-065X-70.4.675>
- Gustafson GT, Miller KB (2017) Systematics and evolution of the whirligig beetle tribe Dineutini (Coleoptera: Gyrinidae: Gyrininae). Zoological Journal of the Linnean Society 181: 118–150. <https://doi.org/10.1093/zoolinnean/zlw014>
- Hämäläinen M, Orr AG (2016) Wilhelm Stüber (1877–1942) collector extraordinaire of New Guinean dragonflies, discoverer of the fabulous Sepik blue orchid, tragic victim of war. Agrion 20: 68–88.
- Jäch MA, Mazzoldi P, Sharma S, Sharma P (2010) Remarkable cases of diurnal mass aggregations of Oriental species of *Orectochilus* subg. *Patrus* Aubé (Coleoptera: Gyrinidae). Koleopterologische Rundschau 80: 15–23.
- Kolmes SA (1983) Ecological and sensory aspects of prey capture by the whirligig beetle, *Dineutes discolor* (Coleoptera: Gyrinidae). Journal of the New York Entomological Society 91: 405–412.
- Liu S-P, Wipfler B, Beutel RG (2018) The unique locomotor apparatus of whirligig beetles of the tribe Orectochilini (Gyrinidae, Coleoptera). Journal of Zoological Systematics and Evolutionary Research 56: 196–208. <https://doi.org/10.1111/jzs.12195>
- Michat MC, Gustafson GT, Bergsten J (2017) Larval description and chaetotaxic analysis of *Dineutus sinuosipennis* Laporte, 1840, with a key for the identification of larvae of the tribe Dineutini (Coleoptera, Gyrinidae). ZooKeys 718: 95–114. <https://doi.org/10.3897/zookeys.718.20726>
- Nachtigall W (1961) Funktionelle Morphologie, Kinematik und Hydromechanik des Ruderapparates von Gyrinus. Zeitschrift für vergleichende Physiologie 45: 193–226.
- Ochs G (1925) Über papuanische Gyriniden. Senckenbergiana 7: 172–177.
- Ochs G (1955) Die Gyriniden-Fauna von Neuguinea nach dem derzeitigen Stand unserer Kenntnisse (Coleoptera, Gyrinidae). Nova Guinea 6: 87–154.
- Polhemus DA (2011) New distributional records for Gyrinidae (Insecta: Coleoptera) on New Guinea and nearby islands, with a checklist of the New Guinea species. Zootaxa 2900: 51–68. <https://doi.org/10.11646/zootaxa.2900.1.3>
- Polhemus DA, Allen GR (2007) Freshwater biogeography of Papua. Ecology of Papua Part 1: 207–245.
- Realzola E, Cook JL, Cook TJ, Clopton RE (2007) Composition of gyrinid aggregations in the East Texas Primitive Big Thicket (Coleoptera: Gyrinidae). The Coleopterists Bulletin 61: 495–502.
- Schlick-Steiner BC, Steiner FM, Seifert B, Stauffer C, Christian E, Crozier RH (2010) Integrative taxonomy: a multisource approach to exploring biodiversity. Annual Review of Entomology 55: 421–438.
- Will KW, Mishler BD, Wheeler QD (2005) The perils of DNA barcoding and the need for integrative taxonomy. Systematic Biology 54: 844–851. <https://doi.org/10.1080/10635150500354878>
- Young FN (1954) The Water Beetles of Florida. University of Florida Studies Biological Science Series 1: 1–238.